Space Weather Technical Forecast

Issued on Sunday, 03 April 2022 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Risk of M-flares, slight chance of X-flares. Active electron fluence likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate in the past 24 hours, with two M-flares originating from the region near the northwest limb where three sunspots are close together. There are now eight sunspot regions on the facing side of the sun, with the most active being the above mentioned AR2975, AR2984 and AR2976 near the northwest limb. Elsewhere on the disc, AR2981 and AR2978 near south centre disc showed some minor changes through the period. The remaining regions are all small and simple. The long period M-flare which peaked around 02/1400 UTC gave a CME, but this is considered unlikely to have an Earth-directed component. No other Earth-directed CMEs have been seen in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, exhibited the likley waning effects of coronal hole/CME activity throughout the period, gradually declining from around 550 to 480 km/s. The density showed a similar trend, initially a little above average levels before reducing to average from 02/1800 UTC. The IMF, Bt, was weak varying between 2 to 8 nT. The north-south component, Bz, varied between +4/-5nT. The phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp 1-4).

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES-16 reached S1/Minor Storm levels at 02/1430 UTC, after an M-flare from the northwestern limb region. Proton flux levels have since declined, and are now well below S1 threshold.

The high energy (greater than 2MeV) electron flux as observed by GOES-16 at GEO was largely at moderate levels with brief peaks at High levels until 03/0920 UTC when it became consistently High. The fluence remains on a steep rising trend and is expected to continue. 2.23e7 integrated pfu was recorded at 03/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-flares are likely through this period with a slight chance of X-flares. The risk reduces through the coming four days as the regions near the northwest limb rotate off the visible disc.

Solar Wind / Geomagnetic Activity: Earth is likely experiencing the waning effects of CME/coronal hole influence. Solar winds will likely remain slightly elevated through much of Day 1 (03 Apr), easing further into Day 2 (04 Apr). No further CME or coronal hole effects are currently expected through Days 3 and 4 (05-06 Apr), with solar winds forecast to be close to ambient levels. Geomagnetic activity is expected to be Quiet to Active (Kp 1-4) with a slight chance of G1/Minor Storm (Kp 5) intervals through Day 1, easing through Day 2, to become mostly Quiet through Days 3 and 4.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is now well below the S1/Minor Storm threshold but remains above normal background levels. This is expected to continue to decline back to normal background levels later in the period. The risk

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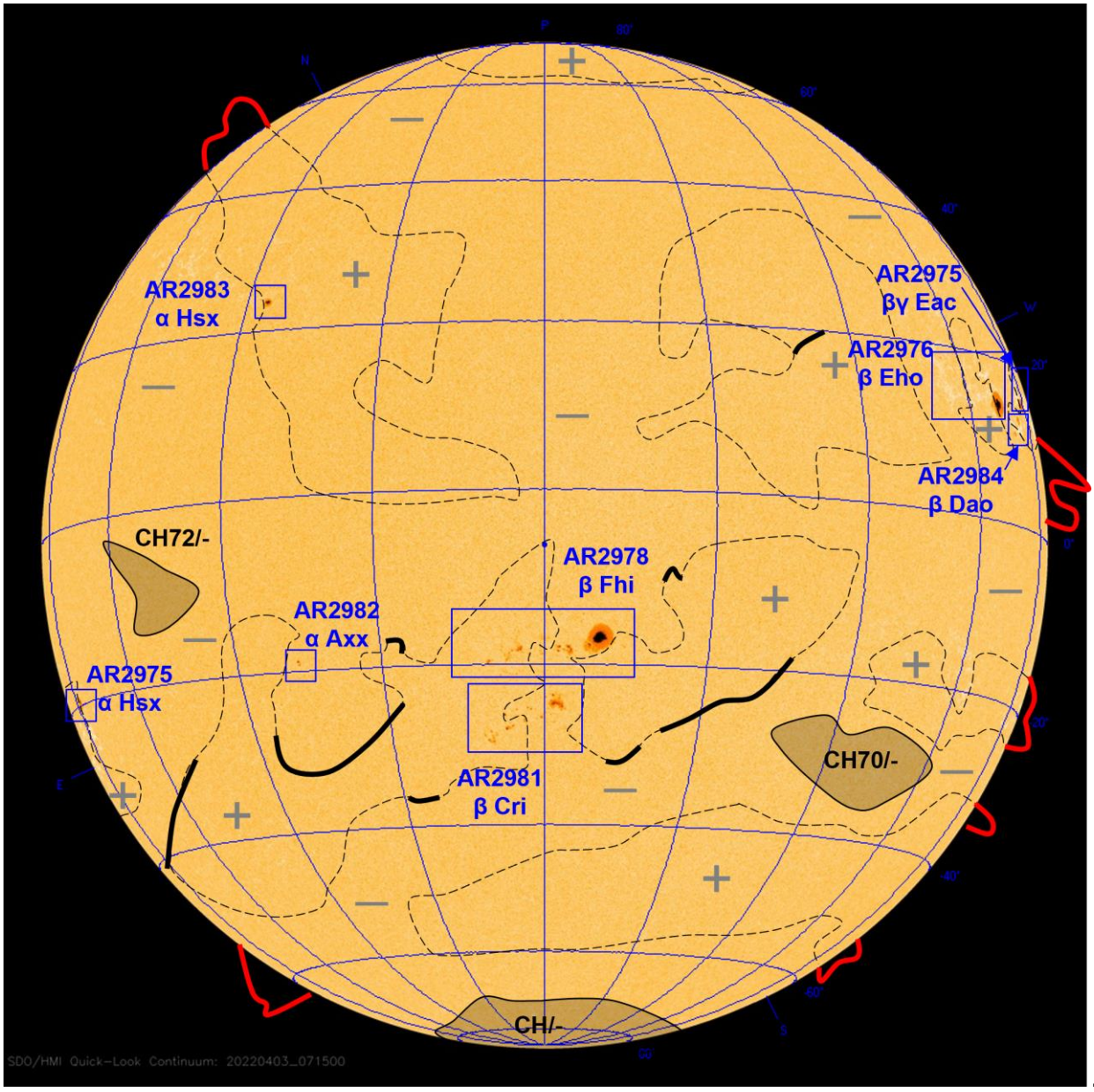
of further proton storms will slowly reduce as the northwestern sunspot regions rotate off the disc.

The high energy (greater than 2 MeV) electron flux is expected to continue to increase through the next few days. It is probable that electron flux will reach High levels at the diurnal peaks, and perhaps remain above the threshold for extended periods. The associated 24-hour fluence will start just below the Active (1e8 integrated pfu) threshold, but on a continued rising trend, likely reaching Active levels later in Day 1 (03 Apr), or by Day 2 (04 Apr). This likely to continue into Days 3 and 4 (05-06 Apr).

Figure 1. Solar Analysis Valid 03/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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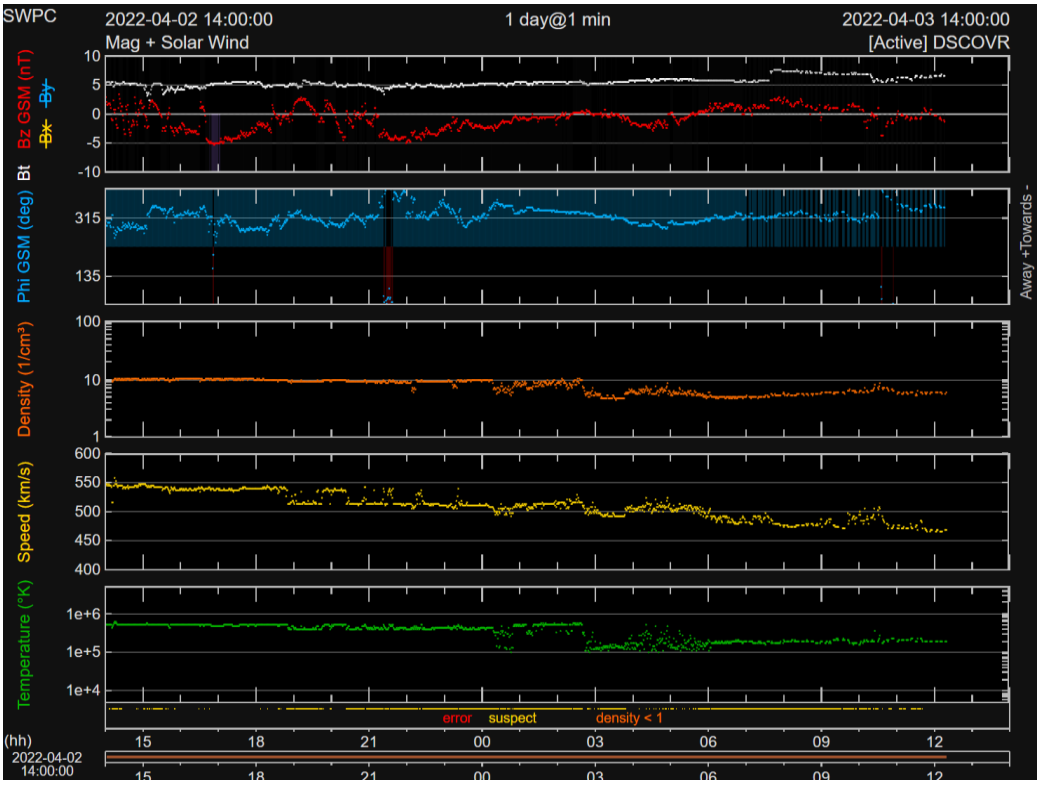
Geomagnetic Storms:

The solar wind recorded at L1 suggests that Earth is exiting the CME influence that arrival early on 02 April, combined with some HSS influence from CH70 or 71. It seems likely that these conditions will continue to wane through much of Day 1 (03 Apr) and into Day 2 (04 Apr). No further CME or coronal hole effects are currently expected through Days 3 and 4 (05-06 Apr), with solar winds forecast to be close to ambient levels.

Geomagnetic activity is expected to be Quiet to Active (Kp 1-4) with a slight chance of G1/Minor Storm (Kp 5) intervals through Day 1, easing through Day 2, to become mostly Quiet through Days 3 and 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SWPC Solar wind trace past 24 hours.



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Radio Blackouts - X-Ray Flares:

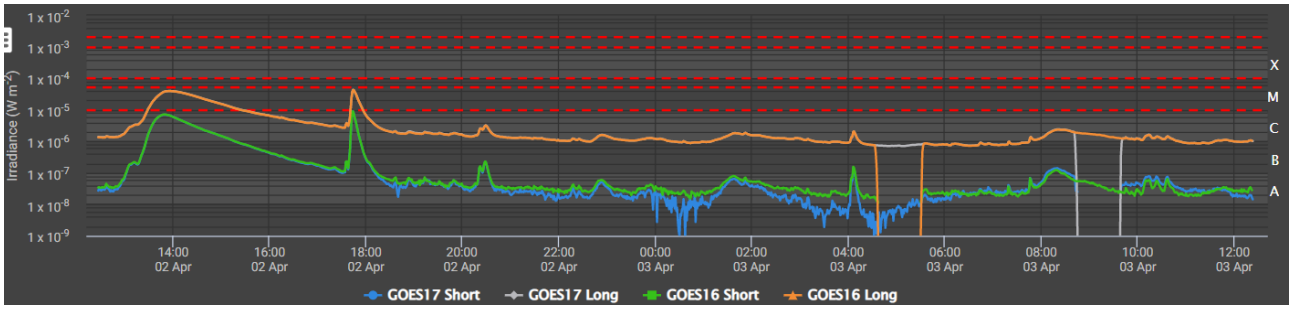
Solar activity has been dominated in the past week by the large and active AR2975, which is now starting to rotate off the northwest limb, along with similarly large but less active AR2976, and a region inbetween them, AR2984. The development of AR2984 itself suggests this northwestern region is still a developmental area.

Near south centre disc are AR2978 and AR2981, both of which have developed further intermediate spots recently and contribute to the flare risk. Other spots are small and simple, although there is a new region rotating onto the southeast limb which cannot yet be classified.

Overall, the flare risk is expected to decline through the coming four days as 2975, 2984 and 2976 all rotate off the disc.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	60	50	40	40
Very Active	R3 to R5 X Class	No	10	10	5	5

Figure 3: X-ray trace past 24 hours.



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Solar Radiation Storms - (High Energy Protons):

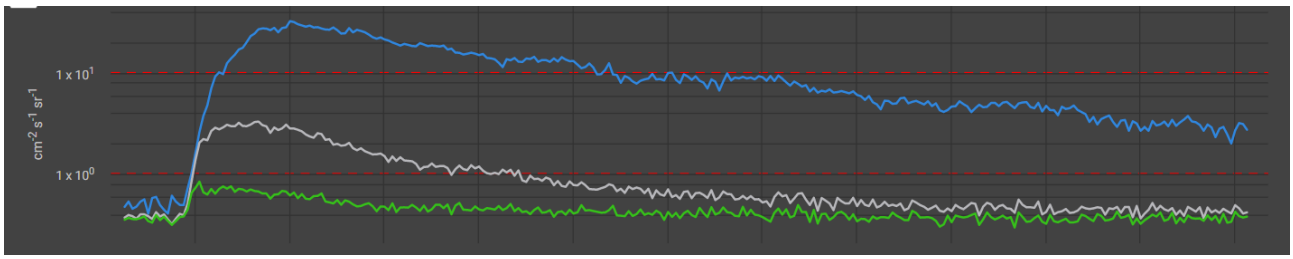
The high energy proton flux (greater than 10 MeV) is now well below the S1/Minor Storm threshold but remains above normal background levels. This is expected to continue to decline back to normal background levels later in the period.

AR2975, approaching the northwest limb, has produced proton-rich flares and continues to have the potential for M- and perhaps low X-class flares. Although this is due to rotate off the disc by the end of Day 1, it will continue to provide a proton risk until it has been off the disc for at least a couple of days. Furthermore, there are a number of other potential flare sources on the disc, although two of these are also due to rotate off during Days 2 and 3 (04-05 Apr), but again will still provide a proton risk until well off the disc.

Two further larger regions near south centre disc, AR2978 and AR2981, will both maintain a smaller level of proton risk one the northwestern regions have rotated off.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	15	15	10	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton trace past 24 hours.



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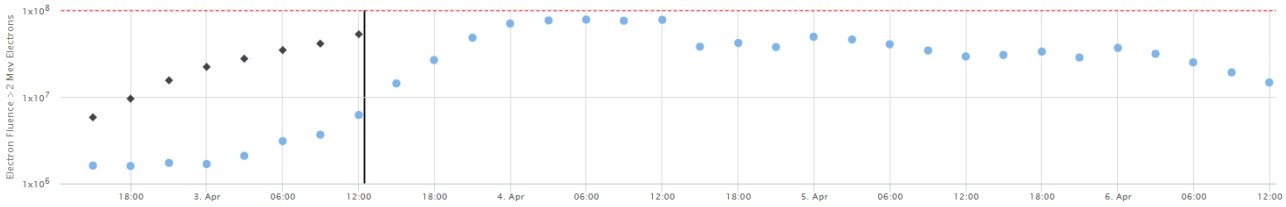
High Energy Electrons Event (≥ 2MeV):

The recent elevated wind speeds are likely to have given some electron charging. With wind speeds now on the decline, the electron flux levels are beginning to respond, these currently above the High threshold. Electron flux levels are expected to spend extended periods of time above the High threshold through the next few days as wind speeds decline further.

The associated 24-hour fluence will start just below the Active (1e8 integrated pfu) threshold. There is expected to be a continued rising trend, likely reaching the 1e8 Active levels either later in Day 1 (03 Apr), or by Day 2 (04 Apr). This trend will likely continue Day 3 and perhaps day 4 (05-06 Apr), though confidence reduces with time.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	70	80	70	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

Figure 5: REFM electron fluence observations and forecast.



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